Response to "Obviousness"

The person of ordinary skill in the art must be credited with ordinary creativity and common sense when considering whether separate teachings could be combined to find an invention obvious.

The point is not whether the skilled person could have arrived at the invention by adapting or modifying the closest prior art, but whether he would have done so because the prior art **incited** him/her to do so.

The history of rope manufacture over the last million years describes a journey dominated by the use of natural fibers. The goal through history has been to make stronger and stronger ropes. To this end, various types of natural fibers were explored. If the load was heavy, a thick rope was woven; if only a weak rope was needed, a thin rope was prepared. There was never an interest in making a thick rope that was weak; that concept was anathema. The goal of rope-makers throughout history has been to produce fibers and ropes that were ever stronger and longer-lasting. The 20th century saw the beginning of the use of synthetic fibers because they offered greater strength, lighter, and longer lasting ropes. Nylon ropes were early in the development, but because of nylon's high elasticity, eventually people turned to polypropylene. Starting in the 1990s there was a transition from using polypropylene ropes to co-extruded polypropylene/polyethylene. The polypropylene/polyethylene ropes are much stronger than polypropylene.

A quote from the homepage of Polysteel Atlantic, the major rope producer for fisheries, says it all regarding the direction of rope construction.

http://www.polysteel.net/

"Polysteel™ rope is made from filaments, which are extruded on a state of the art computerized production line which monitors all aspects of the manufacturing process to extremely tight tolerances. This results in a fiber, which has a minimum tenacity of 7.5 grams per denier, the highest grams per denier of any fiber commonly used in the manufacturing of polypropylene or polyethylene rope.

Polysteel™ is the strongest synthetic rope in its class because of our extremely tight tolerances from fiber extrusion to the finished rope. The result is a rope of unsurpassed quality and consistency. It is Polysteel's unique characteristics, which make it a hands down choice for an industry that demands a highly superior product."

Making a rope with a breaking strength of 2-3 grams per denier is not even in the same universe of thinking as is found not only at Polysteel, but also at all rope manufacturers. They all want stronger, cheaper fibers.

The citation of Katayama and Maeda simply confirms that no rope maker would ever want to use a blend of 3-15% filler with a particle size of 0.25 – 100 microns because that would give a weaker fiber. That's an idea immediately discarded.

If anyone in the past million years wanted to make a weaker rope, the direction of this has always been to make a thinner rope. Given our awareness of history, we conclude that at no time in the last one million years has anyone sought to make a rope of standard diameter that is weak. Since no one in the last million years has deliberately made such a rope, we say that one million years of history proves the concept is not obvious.

I believe I'm the first person to perceive the need for a thick, weak rope. Others of ordinary skill have not seen this need.

Norman Holy
Better Gear, LLC

Note: Added Material is in italics

Whale-safe rope

IN	*Holy, Norman L., Bloomington,* IN, UNITED STATES
PI	US-20050155271 A1 20050721 <--
AI	2003US-000516900 A1 20030908 (10)
	2003WO-US00027932 20030908
PRAI	2002US-000408890P 20020909 (60)
DT	Utility
FS	APPLICATION
REP	*Norman L. Holy, 4676 W. Harvest Lane, Bloomington, IN 47404*
CLMN	Number of Claims: 7
DRWN	*Two Drawings*

AB A rope comprising weak fibers for use with fishing gear, wherein the rope has a diameter between 5/16 inch and 1 inch and breaks between 600 and 2200 pounds of pulling tension. The rope is ideal for netfishing or trapfishing since its use will reduce deaths in whales and other cetaceans which currently occur during netfishing or trapfishing. Netfishing is performed with a net which incorporates the inventive rope as a head rope in the net. Trapfishing is performed with a multisectional rope which is attached to a trap at one end and is attached at the opposite end to a buoy wherein a section of the multi sectional rope attached to the buoy is the inventive rope.

SUMM TECHNICAL FIELD OF THE INVENTION

The present invention is drawn to a rope comprising weak fibers for use with netfishing or trapfishing gear, which breaks in the range of 600-2200 lbs of pulling tension. The breaking property gives the inventive rope the advantage that whales and other members of the cetacean family will not get entangled to such an extent as to cause death.

BACKGROUND OF THE INVENTION

Whales encounter ropes in the oceans of the world used as part of fishing gear and often die as a consequence of this encounter. The number lost is in the hundreds each year. The rope will wrap around flippers, the body, especially the head, the tail (fluke) or is caught in the baleen. This danger extends beyond whales to other members of the cetacean family (cetaceans consist of whales, dolphins, and porpoises).

When an animal becomes entangled in the rope, the animal can die from either the rope cutting into the animal's flesh with the consequence of the animal bleeding to death, or because the wound caused by the rope becomes infected. Right whales, numbering only 350 in the North Atlantic in 2003, are particularly vulnerable to ropes in the ocean since they "skim-feed", i.e., they swim at the surface with their mouths open to engulf and filter out small organisms as food. This type of feeding exposes them to the possibility of taking a rope into their mouths, with the rope catching in their baleen. Of the eight right whales known to have been entangled in 2002 in the North Atlantic, only one was freed of its burden by rescuers cutting the ropes. The fates of the other seven are unknown, but it's highly likely the whales died. An entangled animal is difficult to find in the vast ocean, and even if rescuers are able to locate the animal, it is very difficult to approach close enough to cut the ropes, and such efforts often exhaust the animal. The financial cost of attempting to rescue one entangled whale can be as high as $250,000. Rescuing these animals by cutting the ropes is not an adequate answer to reducing cetacean deaths.

In a recent report (SC/55/BC, 2003) to the International Whaling Commission, authored by Andy Read of Duke University, it is estimated that hundreds of thousands of cetaceans are entangled in gillnets each year. Gillnets can be as long as a mile in length and 10 feet high and have a rope (the so-called "headrope") along the top of the net. Gillnets can be fished either at the surface (driftnets) or on the bottom (sink gillnets). When a whale swims into a gillnet it often rolls, resulting in wrapping the gear around its body. As the whale struggles to free itself, it readily breaks the filaments of the net. But its efforts rarely, if ever, succeed in breaking the headrope. Sometimes the rope will slip from the body and the animal becomes free, but too often the rope remains wrapped around the animal until it dies.

Gillnets are not the only type of gear that is dangerous to cetaceans. Ropes used in the trap fisheries such as for lobsters, crabs, and eels kill many whales each year. This danger to the whale is very real as illustrated by the fact that there are approximately 12 million lobster traps in the Gulf of Maine for about eight months of the year. The story is similar for virtually all the oceans of the world: entanglement of cetaceans in ropes in the marine environment is a worldwide problem.

The history of rope manufacture over the last million years describes a journey dominated by the use of natural fibers. The goal throughout history has been to make stronger and stronger ropes. To this end, various types of natural fibers were explored. If the load was heavy, a thick rope was woven; if only a weak rope was needed, a thin rope was prepared. There was never an interest in making a thick rope that was weak; that concept was anathema. The 20th century saw the beginning of the use of synthetic fibers because they offered greater strength, lighter, and longer lasting ropes. Nylon ropes were early in the development, but because of nylon's high elasticity, eventually people turned to polypropylene. Starting in the 1990s there was a transition from using polypropylene ropes to co-extruded polypropylene/polyethylene. The polypropylene/polyethylene ropes are much stronger than polypropylene.

Conventional rope used on the top of gillnets, the headrope, typically has a breaking strength of 2200-3000 pounds for a rope in the diameter range of {fraction (5/16)}-{fraction (7/16)} inches.

One attempt to reduce the number of whales killed by ropes is to use a breakaway coupling. Break-away couplings typically break at 1100 lb of tension and is inserted between the rope and the buoy. The theory is that the whale can generate 1100 lb of tension and the buoy will separate from the rope and the rope will slide off the animal. This type of invention is claimed by DeDoes (U.S. Pat. No. 6,457,896) and by Paul et al. (U.S. Pat. No. 5,987,710). Break-away couplings are now required in some fishing locations. However, the effectiveness of this approach is unclear, since the use of break-away couplings has not resulted in a measurable drop in whale deaths from ropes. Perhaps some animals are so entangled that the rope cannot slide away even without the buoy attached, or there may be a knot in the rope that prevents it from sliding through the baleen.

It is an object of the present invention to provide an economical novel system for use in fishing gear comprising ropes which reduces the likelihood of cetacean deaths by entrapment and/or entanglement in these ropes.

SUMMARY OF THE INVENTION

An aspect of the present invention is a rope comprising weak fibers for use with fishing gear, wherein the rope has a diameter of {fraction

(5/16)} inch to 1 inch and breaks between 600 and 1400 pounds of pulling tension. ***This appears to be the first rope ever invented in which the diameter of the rope duplicates that currently used by fishermen, but which breaks at a much lower strength.*** The rope is ideal for netfishing or trapfishing since its use will reduce deaths in whales and other cetaceans which currently occur during netfishing or trapfishing. Netfishing is performed with a net which incorporates the inventive rope as a head rope in the net. ***Weak rope can also reduce the number of deaths when it is used as an 'endline', the rope that goes from the buoy to the bottom in a lobster or other trap fishery. The weak rope concept is far superior to the break-away weak link because many rope entanglements occur far from the weak link. If, for example, the rope from a buoy to the bottom is 300 feet in length and the whale hits the rope near the bottom the rope would need to slip along the whale all the way to the buoy before the weak link would snap, releasing the whale. However, the rope is likely to wrap around a fin, fluke, or become caught in the baleen before this happens. Also, a whale often rolls after striking a rope, thus wrapping itself in the rope, which prevents the rope from sliding to the break-away. There is a very high likelihood that the whale will remained entangled in a rope equipped with a weak link for years before it is shed, or that the animal will die. With a weak rope, the whale can break the rope no matter where it encounters the rope. A rope that is uniformly weak throughout its length provides the maximum degree of safety for whales.***

Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

DETD DETAILED DESCRIPTION OF THE INVENTION

In an embodiment of the present invention, the rope at the top of the gillnet, the headrope, has a breaking strength of 300-2200 lb and will still be able to serve its function. Indeed, when a fisherman brings the gillnet up onto the boat from the water, a tension of only a few hundred pounds, just 300-500 lb is applied to the rope itself While the rope should be strong enough to provide a margin of safety, a rope breaking at tensions 2200 lb would be safe for the fisherman, and make it easier for the whale to free itself. A weak headrope, one breaking well below the break strength of conventional ropes, might reduce whale deaths. Preferably, the weak headrope will break between 60-1400 lbs of pulling tension.

In the trap fisheries, such as lobsters and crabs, a rope is used which goes from the buoy at the surface of the water down to the first trap on the bottom. The length of this rope may be as short as 10 feet or as long as 600 feet, depending on the depth of the water where the traps are located. The length of this rope is generally 30% longer than the depth of the water because this extra line is necessary to prevent the ocean current from sinking the buoy.

Whales and other cetaceans become entangled in this type of rope. This entanglement situation will not be resolved by using a weak rope over the entire distance from the buoy to the bottom. When hauling his traps, the fisherman places the rope into a trap hauler (also called a pot-hauler) and brings the traps up to the surface very rapidly, placing tensions of 600 pounds or more on the rope. Sometimes another string of

traps will overlay his traps and the rope must be strong enough to bring both sets of the traps to the surface. This requires a very strong rope.

A rope that would break at 1100 lb could be made of cotton or jute or some other natural fiber, for example, and whales likely could break the rope. Ropes of such fibers are not considered to provide an adequate solution, however, because ropes made of natural fibers biodegrade fairly rapidly in an ocean environment and quickly lose their strength. Thus, ropes of natural fibers do not meet the needs of the fishermen. A rope that initially breaks at 1100 lb, but then breaks at some fraction of this value a few weeks later places the fisherman in danger of being hit by a rope that breaks during hauling. What is needed is a rope that has a nearly constant strength over a longer period of time than would be found by ropes made of natural fibers.

One logical approach to making the ropes weaker would simply be to reduce the diameter of the rope. This obvious solution, however, is not the answer because a smaller diameter rope would cut into the animal at a faster rate. Furthermore, a smaller diameter rope would not work well in the current hauling mechanism on a fishing boat. The problem of cetacean deaths in ropes will not be solved by reducing rope diameters. What is needed is a weak rope having a diameter in the range of current ropes, i.e., {fraction (5/16)}-1 inch. However, the rope could have a diameter of greater than 1 inch, because it would cut into the animal more slowly. Preferably, the weak rope has a diameter of {fraction (5/16)} to 1/2 inch.

One straightforward method would be to make ropes with the ability to degrade photochemically and this would, in theory, reduce incidental cetacean deaths. By mixing agents into the rope that will oxidize in the presence of UV light, will make a rope that photodegrades. Since whales breathe air when they surface, the rope would be exposed to the ultraviolet wavelengths of sunlight. The problem is the useful lifetime of this type of product would be brief and the fisherman might have to store the rope in the dark when not in use.

In light of this need, the present invention provides a new concept in making rope that is sufficiently weak that whales can break it. The weak rope should not degrade too rapidly under use conditions. The rope should also possess certain other properties that are necessary for adequate performance. One important quality, given that gillnets can be up to a mile in length, is that the rope will not stretch too much. A highly elastic rope will skew the net as it is being hauled because the headrope will stretch while the rope ("lead line") at the bottom of the net does not. The rope that is needed should not have an elongation of greater than 25% and preferably is under 20%.

The rope can be made of any thermoplastic resin. The thermoplastic resin includes polyamide, such as nylon 6 or nylon 6/6; polyacrylic; polyester, such as polyethyleneterephthalate; polyolefin, preferably polyethylene and/or polypropylene; or blends, mixtures, or copolymers thereof. Preferably, the thermoplastic resin is polyethylene, a mixture of polyethylene with polypropylene or a copolymer of polyethylene and acrylic acid.

The thermoplastic resin can be crosslinked to reduce the elasticity of the fibers in the rope. Any method known in the art for crosslinking the thermoplastic resins can be used.

One method for making a weak rope is to reduce the draw ratio. In order to increase the break strength of fibers, the fibers are drawn, i.e., pulled in the longitudinal direction after the fibers have been spun. The amount the fibers are drawn is expressed as a draw ratio and is a measure of the increase in length of the fibers once pulled. Experiments were performed to make a weak rope by reducing the draw ratio during the making of the yarn. Instead of a conventional draw ratio of 7-12:1 for either polypropylene or a blend of polypropylene/polyethylene, the draw

ratio was dropped to 6.3:1. The resulting fibers were somewhat weaker, however, the yarn (and of the rope made from it) was too elastic so that the elongation was unacceptable for the desired product.

It has been unexpectedly discovered that weak rope can be prepared by blending materials of limited compatibility with polyolefins. A weak rope can be made by blending 90-60% (by weight) polypropylene with 10-40% (by weight) polyethylene, provided that the two polymers have quite different properties. In one embodiment, the PP and PE polymers have melt flow rate values (MFR, at 230° C./2.16 kg) which differ by a value of at least 5 g/10 min. Preferably, the MFR values differ by at least 15 g/10 min, most preferably, the melt flow index values MFR values differ by 20-50 g/10 min. It is preferred that the PE have a higher MFR than the PP. A low break strength rope is achieved by mixing PE having a MFR >50 g/10 min with PP having a MFR <15 g/10 min. In these PP-PE blends, normally PP will serve as the continuous phase and PE the discontinuous phase. Preferred blends consist of 70-85% PP and 30-15% PE.

In yet another embodiment, PE having a broad molecular weight distribution (MWD=Mw/Mn as measured by size exclusion chromatography with a polystyrene standard) is mixed with PP. Preferably, the MWD is >3, more preferably, the MWD is >4. The break strength of this sample having broad molecular weight PE can be further reduced by blending in 5-15% amorphous PP.

Using dissimilar materials to achieve a weak product extends beyond a blend of two similar but not entirely compatible polymers. One or more organic or inorganic particles can be added to the plastic to improve the properties of the product, e.g., glass fibers are added to plastics to enhance certain strength characteristics, or to reduce warping (see examples: JP 11138534, JP 11000926, EP 794,214, U.S. Pat. No. 6,326,551, U.S. Pat. No. 6,280,468, or U.S. Pat. No. 4,770,926). Other fillers are normally added to strengthen or reinforce a plastic, providing better wear characteristics, as exemplified by U.S. Pat. No. 4,125,406, WO 95/31593, EP 790,335, DE 10032804, DE 10027297, and pre-grant published U.S. patent application No. 2003-039831. There are thousands of references demonstrating the use of fillers added to plastics to improve hardness, scratch resistance, or cut resistance, or wear properties, or lower costs. The key to having improved strength properties is to add the fillers in a relatively small amount.

It has been discovered that if enough filler is added, the strength of fibers, yarns, and ropes can be decreased. In one embodiment, the fibers are prepared with sufficient filler to decrease the tensile strength of the thermoplastic polymer by at least about 25% compared with a thermoplastic polymer without said filler, preferably the length of said fiber is decreased by at least about 50% compared with a fiber comprising said polymer without said filler. Most preferably, the strength of said fiber is decreased by at least about 75% compared with a fiber comprising said polymer without said filler.

Generally substantial weakening of tensile properties will occur if 10 or more volume percent of the thermoplastic is occupied by filler during the manufacturing process. The strength of the fiber, yarn, or rope made from these yarns decreases as the filler level increases. The desired tensile strength of the fiber, yarn, or rope can be achieved by adjusting the amount of filler added.

Adding fillers in the range of 20-70% (by volume) filler is the preferred approach to making weak rope. The filler can be insoluble or completely soluble in water. If the filler is soluble, a small amount may dissolve in seawater during use. However, it was found that even completely soluble fillers such as NaCl are retained in the fibers of the rope even during use, since the filler particles are sufficiently encapsulated by polymers.

To make fibers of the polymers, the average particle size of the filler

additive should be under 120 microns, preferably under 100 microns, most preferably under 50 microns, and even more preferably under 10 microns. The average particle size can be under 1 micron without a deleterious effect on the properties of the composition. In typical extruders, a filtering screen is used to remove large particles (such as insufficiently melted polymers or foreign particles). It has been found that some fillers bridge; thus, even though the particle size would suggest that the particles should pass through the screens without difficulty, the backpressure in the extruder rises very quickly. One option for addressing this problem with some fillers, e.g., starch, is to remove some of the filtering screens in the extruder. Another option is to add a lubricant such as a soap to keep the particles separated. Preferably, the soap is a stearate such as calcium or zinc stearate. Also, the particles can be coated with a polar agent to keep from agglomerating in the nonpolar thermoplastic medium. Such polar agents include ethylene glycol and/or urea.

Another approach to creating weak fibers is to use a foaming agent. The fibers containing closed foam cells may have sufficient volume of cells such that the rope will have a density lower than water and will actually float. However, a floating rope is particularly dangerous to whales since they spend considerable time at the surface to breathe. Thus, these floating ropes should be attached to a weighted object such as a metal trap or a net formed of a denser rope. Also, the rope containing foamed cells could be formed with a heavy filler. Thus, a combination of foaming agent and heavy filler would be acceptable as long as the rope made from such materials sinks.

Useful fillers include starch, talc, silica, barium sulfate, calcium sulfate, calcium carbonate, clay, diatomatious earth, silica, alumina, calcium carbonate, barium sulfate, sodium carbonate, magnesium carbonate, magnesium sulfate, barium carbonate, kaolin, carbon, calcium oxide, magnesium oxide, aluminum hydroxide, titanium dioxide, talc, mica, wollastonite, organosilicone powders, sodium hydrogen sulfate, sodium phosphate, sodium hydrogen phosphate, sodium carbonate, sodium hydrogen carbonate, potassium carbonate, sodium chloride, potassium chloride, alumina trihydrate, calcium silicate, and magnesium silicate calcium silicate, iron oxides, aluminum silicate, sand, clay and mixtures thereof. Preferably, the filler is barium sulfate, iron oxide, and sodium chloride. Most preferably, the filler is barium sulfate which is also known as barite or barytes.

EXPERIMENTAL

In the following samples, unless noted otherwise, the wt % is calculated based on the total weight of the sample. Fibers of Samples 1-21 were tested for tensile strength according to test methods defined by The Cordage Institute, test method CI 1500 and has units of gram/denier. Samples 22-47 were formed into a rope and were measured for "Break Strength." The break strength is measured using 3/8 inch rope with a load cell machine, which is set up to anchor one end of the rope and wind the other end of the rope until the rope breaks and measuring the force (in lbs) necessary to break the rope.

EXAMPLES 1-21

Polypropylene pellets, MFR=3, were mixed with polyethylene (PE1), a LDPE with MFR of 30 and a MWD of 4.3, and/or polyethylene (PE2), a LDPE with MAR of 75 and a MWD of 5.5 and a BaSO.sub.4 blend (46% wt % Blanc Fixe Micro, 13% by weight LDPE of MFR 250, and 43% by weight PP with MFR 80, wherein the wt % is calculated based on the total weight of the BaSO.sub.4 blend). Samples were prepared on a single-screw extruder and the resulting yarns were tested for tensile strength. ***The extruder was a 2.5 inch diameter, NPM extruder with a 24/1 L/D ratio.***

TABLE 1

	BaS0.sub.4	Tensile

Sample	PP (wt %)	% PE1 (wt %)	% PE2 (wt %)	Blend (wt %)	Draw Ratio	Strength g/d
1	75	25	0	0	11.67	8.5
2	75	25	0	0	8.75	7.6
3	75	25	0	0	7.78	5.5
4	82	18	0	0	7.78	6
5	82	18	0	0	7.78	
6	90	10	0	0	7.78	5.9
7	95	5	0	0	7.78	5.6
8	95	5	0	1	7.78	5.7
9	95	5	0	2	7.78	5.3
10	95	5	0	5	10.05	7
11	95	5	0	5	12.17	7.4
12	80	20	0	10	12.17	7.5
13	80	20	0	10	12.17	7
15	80	20	0	20	7.37	4.8
16	80	0	20	0	11.67	6.7
17	80	0	20	0	7.37	5
18	70	0	30	0	6.36	4
19	80	0	20	5	6.36	
20	80	0	20	10	6.36	4
21	100	0	0	30	6.36	3.9

EXPERIMENTS 22-28

Corn starch, "CLINTON" (Archer Daniels Midland) was hand mixed with LDPE with a MFR of 3, BaSO.sub.4 blend, NUCREL 3990 (ethylene-acrylic acid copolymer containing 8% acrylic acid from DuPont), a small particle size sodium chloride (EF 325) from Morton Salt, urea, ethylene glycol, and calcium stearate, and were extruded in 20 lb samples in a twin screw extruder and pelletized. The samples were run on a 2 inch extruder to convert the feed into multifilament yarns. Rope was twisted from the yarns produced.

TABLE 2

Sample	Starch (wt %)	BaSO.sub.4 Blend (wt %)	LDPE (wt %)	PE-Acrylic acid copolymer (wt %)	NaCl (wt %)	Urea (wt %)	Ethylene glycol (wt %)	Calcium Stearate (wt %)	Break Strength (lb)
22	10	10	55	5	15	1	4	0.2	1070
23	20	10	50	5	10	1	4	0.2	960
24	20	10	45	5	15	1	4	0.2	875
25	25	15	45	5	5	1	4	0.2	760
26	5	15	55	5	15	1	4	0.2	1180
27	5	5	90	0	0	0	0	0	2200
28	40	0	50	5	0	1	4	0	650

EXPERIMENTS 29-36

A first sample of 50 wt % BaSO.sub.4 in polypropylene (MFR=12) was mixed with a second sample of 60 wt % sodium chloride in polypropylene (MFR=12). An amount of propylene (MFR=12) was added to the mixture to give the overall compositions in Table 3. These mixtures were run on a 2

inch extruder fiber line. Rope from the yarns and broken on a load-cell machine.

TABLE 3

Sample	BaSO.sub.4 (wt %)	PP (wt %)	NaCl (wt %)	Break Strength
29	10	75	15	1620
30	10	65	25	875
31	10	45	35	620
32	15	55	30	730
33	50	50	0	650
34	0	100	0	2300
35	0	40	60	550
36	45	45	10	650
37	20	80	0	1825
38	0	80	20	1670
39	30	55	15	550

EXPERIMENTS 40-55

20 lb samples of various fillers are added to polypropylene (MFR=12) and are mixed in a twin-screw extruder and pelletized. These samples are ***run through a 2.5 inch diameter, NPM extruder with a 24/1 L/D ratio, and a draw ratio of 7:1. A 3/8 inch diameter rope is made from the yarns and the break strength is measured on a rope testing machine. Blanc fixe is a trade name for synthetic barium sulfate produced by Sachtleben Chemie, GMBH.***

TABLE 4

Sample.	Filler	PP (wt %)	Wt % Filler	Break Strength (lb)	Rope Diameter (in)
40	alumina	75	25	1740	3/8
41	silica	65	35	1850	3/4
42	NaHCO.sub.3	65	35	945	3/8
43	talc	55	45	2100	1.0
44	TiO.sub.2	40	60	1750	3/4
45	Calcium silicate	70	30	1800	3/8
46	KCl	60	40	2320	1.0
47	clay	65	35	1400	3/4
48	barite	50	50	1085	3/8
49	***blanc fixe***	***100***	***0***	***2350***	***3/8***
50	***blanc fixe***	***90***	***10***	***2200***	***3/8***
51	***blanc fixe***	***80***	***20***	***2050***	***3/8***
52	***blanc fixe***	***70***	***30***	***1700***	***3/8***
53	***blanc fixe***	***60***	***40***	***1350***	***3/8***
54	***blanc fixe***	***50***	***50***	***1100***	***3/8***
55	***blanc fixe***	***40***	***60***	***650***	***3/8***

EXPERIMENT 56

Ropes prepared according to Experiment 48, 53-55 were used as headrope on gillnets, bridles, and between the buoy and the highflyer for 2 years. No whales have been killed.